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within one-fifth of the whole volume. This residue being drained off, the frozen part is allowed to melt under cover, so as to exclude the atmospheric moisture. Chloroform thus refined has, by way of testing its durability, remained exposed on the roof in a light brown bottle from November till June without the slightest sign of decomposition.

Professor Pictet has already taken steps to introduce his process into manufacture, and proposes to apply the principle to various other chemical and technical objects. Sulphurous ether, for instance, has by a similar process been produced in a hitherto unknown degree of purity. At the same time, the professor continues eagerly to pursue the various purely scientific inquiries with which he started.

R. DU BOIS-REYMOND.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Dr. Hann and the Föhn.

IN the good old meteorological times — before the advent of Dr. Hann and his fatal misapplication of the mechanical theory of heat to the phenomena of the atmosphere — it was generally considered that the hot winds of Switzerland, the so-called Föhn, had their birthplace in the Desert of Sahara. The good folks thought, in their simplicity, that the warm air which suddenly came upon them must have come from a hot place. They noticed that it always came from a more or less southerly direction, and judged that the sand-dust it carried with it must have come from some sandy region. They felt the sand-dust smart in their eyes, and saw how it discolored the snow white face of the mountains; but the sand-dust did not obstruct their vision further but they could judge that the dust must have got into the air from somewhere, and so they fixed upon the Sahara as the nearest and most likely locality.

It seems, indeed, marvellous that Dr. Hann's opposing theory could have made headway against such glaring and incontestible facts, as it should be much easier to convince the world of a simple and tangible truth than to convert it to the opposite theory, which has nothing whatever of observations of natural phenomena to support it; but when I here propose to maintain the old theory, by taking away the basis of Dr. Hann's, it may not seem unbecoming in me to say a few words in apology for such seemingly reckless behavior.

It is now nearly two years ago I published, through these columns, the rudiments of a theory of the atmosphere which is more or less diametrically opposite to the prevailing ideas on the subject. Rain was supposed to be due to expansion of moist air, and I found by experiments that it must be due to compression, etc. As far as I could ascertain, meteorologists had no objection to urge against my theory, but on further investigation it became clear to me that they possessed a high-priest, or *Dalai Lama*, in Dr. Hann, without whose sanction no new theory could be seriously considered by reputable meteorologists of any standing, and as he refrained from expressing himself directly on the subject, the matter was put aside for the time being. Dr. Hann, however, gave indirectly vent to his opinion; a few weeks after the publication of my theory Dr. Hann handed in to the Vienna Academy of Science a paper wherein he held forth that the established theories on the atmosphere required considerable modifications, and the modifications he proposed were all an approach towards the views which had immediately before been set forth by the present writer. This paper caused considerable discussion, but nobody seemed to consider the high-level observations on which he proposed to base these modifications of any real value. Any further approach to my views would undoubtedly have led Dr. Hann to upset his own theory of the Föhn, — a theory which has brought its author no inconsiderable renown during the past years, — and that any man should upset his own reputation as a philosopher

could hardly be expected; and there is so far nothing to be said against his silence, as all is fair in war and love, and to gain time is the great object in all cases of emergency.

There is, however, a time for every thing, and as nearly two years have elapsed since I published what, in my humble opinion, is the true theory of the atmosphere, it may be about time for me, and my duty also, to endeavor to upset the chief obstacle against its adoption, which I consider Dr. Hann's Föhn theory to be.

I take occasion from an article by Mr. Rotch, on "Mountain Meteorology," in *American Meteorological Journal* (August, 1891), wherein this staunch upholder of Dr. Hann's views has very ably tried to systematize the aspects of the prevailing meteorological theories from this particular point of view. It is always a laudable endeavor, of any author, to try systematically to combine into a collected whole the varying theories concerning any particular branch of this science, as it enables the critic to mark out the weak point. The most consistent or systematic treatise on the atmosphere as a whole, which the present writer is acquainted with, is the "Elementary Meteorology," by Mr. R. H. Scott, and the remarkable candidness of its author made it a comparatively easy task for the present writer to point out, that, according to the causes of rain given there, we should not get any rain at all if we were to believe the gentlemen who had the atmosphere "in charge," so to speak. As I on that occasion dealt extensively with the question of the effect on the humidity of the air caused by ascent or descent of the air, I may at present confine myself to discuss exclusively the question of change in temperature caused by ascent or descent.

Mr. Rotch says, on page 154: "It has been shown by Dr. Hann that the Föhn owes its extreme warmth, as well as its dryness, to the descent from the ridges on the north side of the Alps, and that it does not bring it from further south. The warmth of the Föhn is explained by the fact that a mass of air sinking into one of higher pressure is warmed at a rate of one degree for each 300 feet of descent, and a rapidly sinking stream of air, which is so quickly heated, must be relatively very dry." And a few lines above we read: "The cool night wind (from the mountains) is caused by the sinking of the cold air into the bottom lands, and is most intense in narrow valleys, where there is great difference between the temperature of the valley and the plain," and again, during Föhn the temperature "rises sometimes 60° F. above the normal."

The unbiased reader cannot help noticing the anomaly that the mere descent of air is (1) in case of Föhn accused of causing a considerable rise in the temperature above the normal, and (2) in case of the night wind an equally considerable lowering of the temperature below the normal.

This contrast becomes even more drastic when Mr. Rotch says, page 151, "Slowly descending currents of cold air fill the valleys like rivers, while the summits receive the air warmed dynamically by descending from a greater height; and it seems obvious that the author has a little private theory of his own that it makes a great difference whether the air is descending slowly or not, whereby he tries to patch over the glaring discrepancy."

We may now set to work to put these contradictory theories to their proper test, thereby confining ourselves to statements contained in the article itself. It is thus truly mentioned that the air is warmed at the rate of 1° F. for each 300 feet of descent and cooled at the rate of 1° F. for each 300 feet of ascent, but we also find mentioned another fact, equally true, that, on an average, or under normal conditions, the temperature of the atmosphere decreases at the rate of 1° F. for each 300 feet rise; and this fact throws a peculiarly instructive light on the whole subject. It shows that under normal conditions air rising to any height will during the ascent be cooled by expansion at such a rate that wherever it goes it meets with air having a temperature exactly equal to its own, and also that air descending to any level will for a similar reason meet with air having a temperature exactly equal to its own, wherever it goes. In other words, for air arriving at any particular place to have an abnormally high or low temperature it must have had an equally abnormally high or low temperature at the locality where it started from.

Thus, in case of the Föhn wind, for this air to arrive in the valley at a temperature 60° F. above the temperature normally found there, it must have been heated 60° above the temperature normally found at the summit of the mountains from where it started, and it then remains with Dr. Hann to explain how this air acquired the abnormally high temperature before it commenced to descend, and until he has done this he can have no right to claim that he has added one particle towards the explanation of the phenomena of the Föhn; and, even if he was able to get over this difficulty, it still remains for him to explain the phenomenon of the sand-dust, before it can be recognized that the birthplace of the Föhn is anywhere but in the Desert of Sahara.

The phenomenon of cool night wind from the mountain and the accompanying higher temperature on the mountains than in the valleys find a ready explanation from the same premises. During clear nights the air nearest the earth's surface gets abnormally cooled through radiation, and the radiation is more intense on the mountains than on the plains. The cool contracted air will run off the slope of the mountain and accumulate in the valleys, while its place on the mountain-side is immediately taken up by air which has not as yet been cooled down by radiation. In the valleys the temperature gets lower than on the mountains, or the plains, because the cooling effect of radiation is there acting upon air which has previously been cooled considerably down by radiation on the mountain, and it is clear that the temperature must sink lower when radiation is acting upon air already cooled down, than when the temperature of the air was higher to start with.

The present writer has, on several occasions, tried to induce so able and prolific writer as Professor Hazen to attack his views for the sake of an argument, but the professor seems to decline to enter upon a discussion with any body who does not belong to the "meteorological camp," as he calls it. Now, be it said, in all kindness, that in our advanced age every body seems to be entitled to express his opinions on any scientific subject when he feels himself convinced of having found something new which may add to the progress of science, and also be entitled to a fair hearing; but be it said, as my impression when I accidentally arrived in the meteorological camp, all the inmates seemed to have decamped previously, leaving no one behind to shake hands with me; and this I thought a little discouraging. Dr. Hann may be a most excellent director of the Hohe Warte, and it may seem not a little reckless for an outsider to attack his theories; but it should be remembered that even a blind man may sometimes find a seed, — although a civil engineer of high training may not be entirely blindfolded, — and if there be any truth in the maxim of Dr. Hann's countryman, Feuerbach, "that no philosopher ever yet occupied a professorial chair in philosophy," so it might possibly be equally true that no philosopher in meteorology ever yet sat on Hohe Warte, however great his attainments as director or weather forecaster might have been.

FRANZ A. VELSCHOW, C.E.

Brooklyn, Nov. 9.

Auroral Phenomena.

As Dr. Veeder has mentioned in his description of the aurora of Sept. 9, in *Science* for Nov. 6, some phenomena not ordinarily accompanying auroral displays that were also visible here, some notes made at the time may be of interest.

The aurora on that evening was unusually fine, probably the most brilliant observed in four years. It began about 7 40 P.M. as a faint arch five degrees above the northern horizon, which gradually became higher until a maximum height of eight degrees was reached at 8.15 P.M. Shortly before this time two smaller arches appeared beneath the principal arch, and soon afterward the ends of the three joined together, forming a serpentine band. This band at 8.20 P.M. broke up into brilliant streamers, which were constantly changing in appearance and length, alternately fading and becoming bright again.

This continued until 8.50 P.M., when the display reached its maximum brightness and the streamers their greatest length. The elevations of the ends of the streamers above the horizon were

measured with a theodolite at times, the highest being at a height of 56°, though many exceeded 45°.

Between 9.15 and 9.30 P.M. the aurora diminished greatly in brightness, and at 9.25 two bands extended toward the zenith from the east and west respectively, joining together at 9.27, forming the narrow band that Dr. Veeder saw. This band was apparently of a uniform brightness, approximating that of the Milky Way, and continued, through the period of minimum brightness of the aurora, from 9.25 to 9.35 P.M. After 9.35 P.M. the aurora became brighter, and was visible at 11.40 P.M.

This band of light was seen at Nashua, N.H., and in this vicinity, while the aurora has been reported as visible at several places in Europe as well as America.

A similar band of light, extending through the zenith from opposite sides of the horizon, was observed during the aurora of May 20, 1888, which was described in *Science* by several observers during the succeeding month.

Five auroras were visible during September four of which occurred on the 7th, 8th, 9th, and 10th, respectively, — an unusually large number for such a short period of time.

S. P. FERGUSON.

Blue Hill Observatory, Readville, Mass., Nov. 20.

AMONG THE PUBLISHERS.

D. C. HEATH & Co., Boston, will soon publish *Business Law*, prepared by Alonzo P. Weed. This is not only a text-book for business colleges and the business courses of schools and academies, but it is desirable for the desk of the business man.

— Charles F. Lummis, a Harvard man, who has lived for many years in New Mexico, begins in the Christmas *Scribner* a group of articles on that little-known territory, with its population of Pueblos, Mexicans, Navajos, and Americans. The articles will be illustrated from the author's own photographs, which are unusual in subject and variety.

— The October number of the "Papers of the American Historical Association" contains six articles. The first is a brief account of "Slavery in New York" under the colonial government. Then follow two papers on certain aspects of our national Constitution, the one on "Congressional Demands upon the Executive for Information" being the most suggestive. The next is "A Plea for Reform in the Study of English Municipal History," and there is also a longer article on the "Yazoo Land Companies," giving an account of a gigantic land speculation of a century ago, in which political intrigue played a prominent part. But the article that will be likely to interest the greatest number of readers is that on "The Lost Colony of Roanoke," by Stephen B. Weeks. The colony planted by Raleigh on Roanoke Island has always been supposed to have perished; but in 1885 Mr. Hamilton McMillan of North Carolina advanced the theory that the colonists retreated inland, where they ultimately intermarried with some friendly Indians, and that the Croatan Indians, now living in the western part of the State, are their descendants. The evidence for this theory in the physique, the traditions, and the names of those Indians is really quite striking; and persons interested in our early history will like to read Mr. Weeks's paper.

— A second edition of "Modern American Methods of Copper Smelting," by Dr. E. D. Peters, Jun., has just been published by the Scientific Publishing Company of this city. The book has met with great success, the demand for it having long since exhausted the first edition. The entire book has been practically rewritten, and new chapters have been introduced on the electrolytic assay of copper, the smelting of copper with gas in regenerative furnaces, and the smelting of copper-nickel ores in water-jackets. Additions of great importance have also been made to the chapter on reverberatory smelting, and this portion of the work has been illustrated by nine full sized pages, which form what is said to be the most complete set of detailed working drawings of the kind ever published. The arrangement of the book has been improved; and in addition to the full alphabetical index at the end, a detailed table of contents has been prepared that will be a great aid to the reader. The author has brought a riper ex-